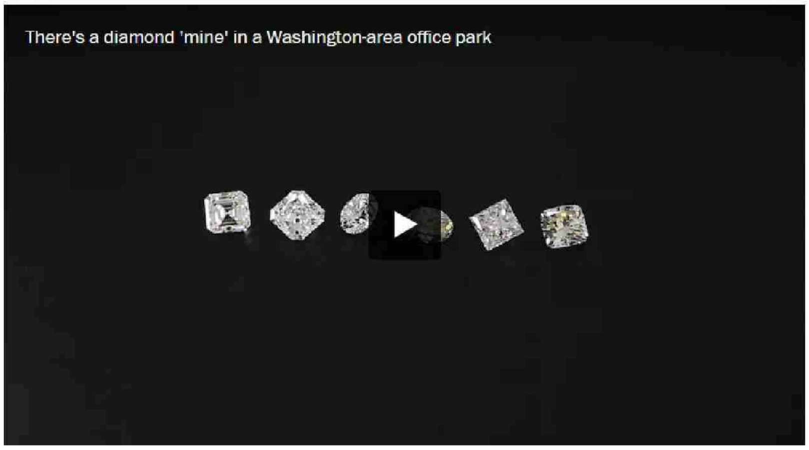
EXHIBIT 32

Science

Forget the ring: Lab-grown diamonds are a scientist's best friend



Video: There's a diamond 'mine' in a Washington-area office park (Gillian Brockell/The Washington Post)

By **Sarah Kaplan**
Reporter

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At a drab office park in a Washington suburb, in an unmarked building's windowless lab, Yarden Tsach is growing diamonds.

Not rhinestones or cubic zirconia. Diamonds. *Real* ones. In a matter of eight weeks, inside a gas-filled chamber, he replicates a process that usually takes billions of years in the bowels of the planet. Carbon atom by carbon atom, he creates nature's hardest, most brilliant and — if decades of advertisements are to be believed — most romantic stone.

No outsiders get to witness this genesis, though. WD Lab Grown Diamonds, where Tsach is chief technology officer, guards its approach as zealously as its address. These are the measures a company takes when it's a target — of fierce competitors, potential jewel thieves and a traditional industry that would very much like it to go away.

"Everything is after us," Tsach says. He doesn't mean it as a joke.

Most Read Science

A cut and polished diamond produced in the lab. (WD Lab Grown Diamonds)

Until the middle of the past century, all of the world's diamonds originated more than 1 billion years ago in the Earth's hot, dark interior. Tremendous temperatures and pressures forced the carbon atoms there to link up in a flawless, three-dimensional lattice that would prove incredibly strong and equally effective at bending and bouncing light. The result was a crystal — a gem in the rough that, once cut and polished, would dazzle with unmatched radiance.

Yet getting those stones up to the surface has required an enormous — and sometimes bloody — effort. The environmental impact of diamond mines is so sprawling that it can be seen from space. The humanitarian cost of some gems is also staggering: children forced to work in mines, "blood diamonds" sold to finance wars. The Kimberley Process, which certifies diamonds as "conflict free," was established in 2003 to stem the flow of these stones into the global market. But critics have argued for tougher measures; in 2011, one of the leaders of the campaign to implement the vetting program pulled out after concluding that it had failed.

These images from NASA's Landsat satellites show the transformation of a subarctic landscape from 1998 (left) to 2013 (right) as Canada's Diavik Diamond Mine was built. (Robert Simmon/NASA Earth Observatory/Data provided by USGS)

Traditional diamond producers say only a small fraction of diamonds are suspect these days because of steps they've taken to ensure that mines are socially and environmentally responsible. They push back against the appeal of lab-grown stones, suggesting the man-made versions aren't on par with those dug out of the ground. The most recent ad campaign from the Diamond Producers Association, which features hipster couples frolicking amid gorgeous nature scenes, is called "Real is

Rare."

Their argument is unspoken but clear: No one should propose to a sweetheart with a gem that was made in some drab office park.

Tsach shakes his head and holds up one of his company's products. It glitters in the fluorescent light.

"This was grown here next to Washington, D.C., by people with health insurance and sick days and vacation days," he says. "Is it a real diamond? ... A person can make up his own mind."

[A super-cool science story about a really cold thing]

Scientists have been creating diamonds since the 1950s, mimicking the conditions deep within the Earth by heating carbon to extreme temperatures while squeezing it in a hydraulic press. But it took them several decades more to cultivate large gem-quality stones. These were still not as large or as clear as the best traditional diamonds, and most were colored yellow or brown from the nitrogen required to stabilize the growing process. Still, the traditional diamond companies were on edge.

"Unless they can be detected," a Belgian diamond dealer told Wired in 2003, "these stones will bankrupt the industry."

Today, nearly a dozen companies worldwide produce diamonds that are all but indistinguishable from mined stones — good enough for any engagement ring or Valentine's Day present. Four more companies focus solely on diamonds for use in factories and research labs. One of the latter, Element Six, is run by the famous diamond-mining company De Beers.

"The industry is as viable as it's ever been," said Rob Bates of the diamond trade publication JCK.

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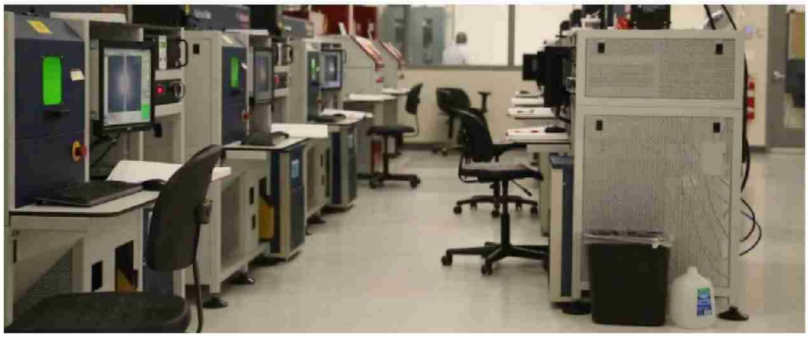


After eight weeks of growing, diamonds are given an initial cut by lasers. (Gillian Brockell/The Washington Post)

WDLG Diamond relies on a technique developed by scientists at the Carnegie Institution for Science. It starts with a tiny sliver of diamond that acts as a substrate on which the new stone can grow. This "seed" is placed inside an airless chamber, which is pumped full of hydrogen and methane that become a plasma, a hot, ionized gas. The now highly charged carbon atoms from the methane are attracted to the seed at the bottom of the chamber and begin to forge the super-strong bonds that characterize a diamond. As each new atom is added, it hews to the diamond's lattice structure, falling into place like a piece of a puzzle.

"The details are still not completely understood," said Russell Hemley, who led the development of the process at Carnegie's Geophysical Laboratory in the late 1990s. "But the presence of hydrogen biases the deposition of carbon as diamond rather than graphite. That's how you can grow a diamond outside of what's known as its stability region" — meaning the extreme pressures and temperatures found in the Earth's mantle.

[The man who uncovered the secret lives of snowflakes]

When a stone reaches a certain size, Tsach's team puts it in a second chamber and zaps it with a laser to excise the seed diamond and condition the new gem's surface. What emerges from this process is small and square, about the size of a thumb nail. It's dark from the thin film of graphite (the other form of pure carbon) produced by the laser-cutting process. It's also distinctly unimpressive. It looks like a bit of plastic.

Then off it goes, to be cut by a commercial polisher. Tsach chooses a pattern using special software that helps him maximize the number of gems the company can get from the stone while avoiding any of its imperfections. This process is like Tetris, if Tetris pieces were worth thousands of dollars.

Rough diamonds, before they have been cut and polished. (WD Lab Grown Diamonds)

The last stop is the International Gemological Institute, where the gem is graded and certified. Per federal regulation, it's also inscribed with "Laboratory grown in the USA" and a serial number to distinguish it from a mined diamond. The label is microscopically small, but growers wish they could ditch the clinical-sounding term. It's not exactly swoon-worthy.

[Dear Science: Could my body include an atom from Shakespeare?]

Sales of lab-grown stones make up about 1 percent of the global commercial diamond market, but a 2016 report from investment firm Morgan Stanley suggested that proportion could jump to 7.5 percent by the end of the decade. In one unlikely scenario, analysts said, lab diamonds might become so ubiquitous that the entire traditional market collapses.

After all, that market depends on sentiment and scarcity. The combination is what made De Beers's famous "a diamond is forever" campaign so potent. It turned diamonds into the ultimate symbol of eternal love, stones that were to be treasured and never — perish the thought — resold. The genius strategy has helped to ensure diamond companies control supply.

But lab-grown jewels shatter the illusion. They can be made on demand, in a matter of weeks, and they cost an estimated 10 percent to 40 percent less than a gem that comes out of the ground. Technology being what it is, it's likely they'll get even cheaper.

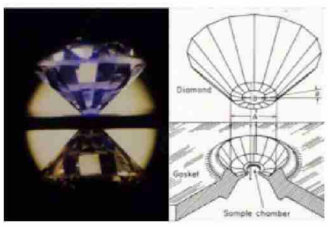
So what happens then? Will a diamond be just another shiny rock?

"A diamond is an extraordinary material," Hemley said, indignant. He noted the stone's strength, optical qualities and resilience. "Its intrinsic properties are remarkable."

[In breakthrough experiment, scientists shine a light on antimatter]

Wearing it on your finger is just about the least interesting thing you can do with a diamond. The stones are one of nature's best heat conductors and electrical insulators; when used in the production of semiconductors, they keep the silicon from overheating. They're also used to make drill bits, solar panels and high-power lasers.

Someday, tiny diamond nanoparticles might even help deliver medicine to cells struck by cancer.



A photograph (left) and illustration (right of a diamond anvil cell.)

Lab-grown gems extend the possibilities much further — allowing scientists to explore questions about the cosmos. Hemley, who is now a professor at George Washington University, is working with WDLG Diamonds to develop better stones for instruments called diamond anvil cells. By squeezing together two diamonds — the only material capable of withstanding such pressures — scientists can

simulate the conditions found inside planets. They can compress the microbes that dwell in the Earth's crust to understand how they resist the crushing weight of the rock above them. They can model the behavior of gases that endure the high pressure of gas planets such as Saturn and Jupiter.

And they can push materials to such extremes that they take on new properties. Just last month, Harvard physicists claimed that they'd used a diamond vise to turn hydrogen into a metal — a step toward developing a new type of superconductor.

Diamonds' transparency is vital in these experiments. It allows researchers to send beams of light, from X-ray to infrared, through the anvil cell to probe the material inside. Reinhard Boehler, a scientist at Carnegie and the Oak Ridge National Laboratory in Tennessee, uses neutron beams to probe elements such as carbon and hydrogen at very high pressures. The task requires diamonds that are perfect as well as large, which means they can only come from a lab. Traditional diamonds often contain flaws, and those of any significant size are far too expensive — especially because Boehler's lab breaks so many of its anvils.

He chuckled, "Diamonds, for us, are not forever."

Correction: An earlier version of this article misidentified Russell Hemley's role at Carnegie's Geophysical Laboratory. He oversaw the development of the diamond process in the 1990s and served as director of the lab from 2007 to 2013.

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Sarah Kaplan
Sarah Kaplan is a climate reporter covering humanity's response to a warming world. She previously

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